

CENTRAL INTELLIGENCE AGENCY

REPORT NO.

## CD NO.

COUNTRY Yugoslavia

DATE DISTR. / Oct 1953

SUBJECT Irrigation and Agriculture

25X1

NO. OF PAGES 6.

PLACE  
ACQUIRED

NO. OF ENCLS.  
(LISTED BELOW)

DATE  
ACQUIRED

SUPPLEMENT TO  
REPORT NO.

DATE OF INFORMATION

25X1

THIS IS UNEVALUATED INFORMATION

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES; WITHIN THE MEANING OF TITLE 18, SECTIONS 793 AND 794, OF THE U.S. CODE, AS AMENDED. ITS TRANSMISSION OR REVELATION OF ITS CONTENTS TO AN RECIPIENT BY AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW. THE REPRODUCTION OF THIS FORM IS PROHIBITED.

## Effect of Topography on Agriculture and Irrigation

1. There are various different climatic areas within Yugoslavia ranging from a mild Mediterranean climate to a harsh semi-arid climate. This fact, together with other factors, has created different soil conditions which in turn have influenced the development of various types of agriculture and farming methods.
2. The most important agricultural region is the Vojvodina which is situated in the northeast part of the country and comprises that part of the Carpatho-Pannonian Basin where the Danube, Tisa, Tamiš, and Sava rivers are located.

25X1

**CLASSIFICATION**

CONFIDENTIAL/

### DISTRIBUTION

CONFIDENTIAL

- 2 -

3. Topographically, there are three clearly distinguishable terraces and some hilly regions. As the Vojvodina is a generally rather flat country, the development of agriculture has been mainly dry farming of wheat and corn.
4. The First Terrace. This lowest inundation terrace along the Danube and other rivers comprises a relatively narrow strip of from one to 10 kilometers in width. The soil on this terrace is of relatively recent origin and is of an alluvial type. Because it is light and warm, this soil is highly fertile and especially suitable for growing vegetable crops. In the Tisa valley there are very heavy soils which are harder to cultivate but just as fertile. The ground waters of this terrace are relatively close to the surface and therefore suitable for irrigation. These soils suffer least from drought, a fact clearly shown in 1952, the worst drought year in the last 60 years, when these soils still produced a medium yield.
5. The Third Terrace. This is the highest terrace and comprises the northern part of the Backa, a small area near the Danube and the north-west part of the Deliblatska plateau (sand). In these areas there are cernosem type soils which have developed under conditions of steppe vegetation on the underlying loess. In normal years the ground water table of this highest terrace lies approximately eight to 14 meters under the surface. In extremely wet periods after the underlying sandy layers have been filled to capacity, this ground water seeps to the surface in a few low spots; however, this does not occur to a damaging extent.
6. The cernosem type soils are the most fertile soils, but the yields decrease considerably in dry years. The main crops are wheat and corn. The land is rolling and there are some deep gullies cut by small rivers which dry out in the summer.
7. The Second Terrace. This comprises the remaining part of the Vojvodina except the Fruska Gora mountains and hills around Ursac. All types and varieties of soils are found here, depending on local conditions (high and saline ground water, varying topographic conditions). The prevalent soil, however, is the cernosem and the livadska crnica, a soil similar to the cernosem but of hydrogen origin in lower layers. In the lower parts of this terrace high and saline ground water has caused the formation of saline soils of solonjec, soloncak type and in the south-eastern part of Vojvodina (Srem) also the solodj type, saline and acid. On this terrace in the Banat are found the ritska crnica which is an extremely heavy soil without calcium. With the exception of the saline parts, the soils of this terrace are as fertile as those of the third terrace. The yields vary greatly, however, because rainfalls are not only insufficient but also are badly distributed in regard to the growing season.
8. Under dry farming methods practiced in the Vojvodina, average yields are:

wheat	12	cubic meters	per hectare
barley	14	"	"
oats	12	"	"
corn	20	"	"
sugar beets	200	"	"
sun flower (seed)	10	"	"
hemp	60	"	"

25X1

CONFIDENTIAL

CONFIDENTIAL

- 3 -

9. In dry years the crops planted in the spring suffer more than crops planted in the fall. With irrigation an increase of yields of 50 to 60% or more may be expected.
10. Only occasionally do late frosts cause damage to potatoes, vegetables and fruits. Damage through plant diseases are even less frequent.
11. Considering the basic biological factors such as light, temperature, plant nutrition, water, and air, there is never a lack of light and warmth for plant development in Vojvodina. The same applies for plant nutrients except for the post-World War II period when the sharp decrease in the number of livestock brought about a serious lack of fertilizer.

#### Problems in Agriculture and Irrigation

12. The most important problem facing Yugoslavia as regards agriculture is that of finding sufficient water for irrigation of crops. This is clearly apparent in the records of the past three years. The year of 1950 was one of extreme drought with very low yields; in 1951, there was sufficient rain during the growing season of eight months and consequently very high yields while 1952 was the worst year for agriculture in recent Yugoslav history.
13. A normal and well balanced system of crop rotation will have to be introduced in order to avoid serious deterioration of the rich cernosem soils. The average annual rain fall of 625 mm is quite insufficient, and it is therefore necessary to irrigate the lands of the Vojvodina in order to stabilize and increase yields.
14. At present there are only 3,500 hectares in the Vojvodina which are irrigated. Before World War II there was practically no irrigation practiced there. Between World War I and II irrigation was introduced in the Banat on an area of approximately 400 hectares when sprinklers were used for flower seed production, and on an area of 250 hectares in the Backa where surface irrigation was used for rice along with the use of some sprinklers.
15. After the heavy damage caused by the recent drought years, the government decided to introduce modern irrigation methods in order not only to solve present agricultural problems, but to provide for future population which is increasing at the rate of 200 thousand persons yearly.
16. Some of the special problems in irrigation are:
  - (a) Provision of a method of providing stability of the earth banks of canals.
  - (b) Construction of the Tisa dam with mainly silt and clay soils.
  - (c) Lowering of ground water tables.
  - (d) Control of irrigation waters (drainage).
  - (e) Development of educational and administrative methods and techniques in order to introduce irrigation into regions where only dry farming has been practiced for many generations.

Of these problems, (a) and (c) are the most serious.

#### Planned Improvements

17. In the Vojvodina, which is the wheat reservoir of Yugoslavia, the construction of the Danube-Tisa-Danube Project has been authorized. This will be a multiple purpose project for:
  - (a) Flood control, principally in the Banat region.

CONFIDENTIAL

25X1

25X1

CONFIDENTIAL

- 4 -

- (b) Control of floods caused by unregulated water entering Yugoslavia from Hungary and Rumania.
- (c) Improvement of existing drainage systems based on gravity flow rather than installation of systems requiring pumping.
- (d) Irrigation of the largest possible portion of the Vojvodina. Irrigation in southern Yugoslavia is also vitally important but the effect on the country's economy as a whole is not as important as that of the Vojvodina. According to this plan, a half million hectares shall be irrigated within the next 30 to 40 years. Later, less accessible and more costly areas can be developed and reclamation of saline soils can be undertaken. This reclamation will amount to an additional 400 thousand hectares.
- (e) Lowering of the ground water tables where it causes salinity or at least preventing a rise in ground water tables due to irrigation, through rapid drainage of surface waters by open ditches and through drainage by underground pipes, especially in the central part of the Backa where the ground water is closest to the surface.

Underground drainage is of special interest because Yugoslavia has had little experience in this field. Ceramic tile pipe used in the past has been unsatisfactory, apparently because the diameter of the pipe was too small. Larger diameter pipes are to be tried in the future.

Twice within the last century the ground water table has risen so high that cultivation of some 400 thousand hectares became impossible. It is believed that well developed drainage systems will improve this situation by rapidly carrying off surface waters so that cultivation will always be possible.

Yugoslav engineers are also considering the possibility of lowering the ground water table before irrigation by pumping as a preventive measure. Sufficient hydroelectric power will be available in the future when various power plants now under construction are completed.

- (f) Provision for navigation on the irrigation canals. The size of the main canal system will be sufficient for the navigation of vessels up to one thousand ton loads. The medium canals will be sufficiently large to allow navigation by vessels carrying two or three hundred ton loads. This water transportation will make the carrying of bulk products much more economical for both domestic and foreign trade.
- (g) Full utilization of water power at all stages is desired. The first such utilization will be that afforded by the development of the Tisa power project.
- (h) Construction of food processing plants along the main canal is planned. These plants will procure their water supply from the canals.

#### Description of Canals

18. The main canal profile is as follows:

Depth of canal	7 meters
Depth of water	4 " "
Width of canal bottom	20 "
Width at water level	50 "
Velocity of water	0.30 cubic meters per second
Slope of bank	1:3

The profile is of trapezoidal or parabolic shape.

The main canal and laterals will be lined to avoid seepage which could cause a dangerous rise in the ground water table.

CONFIDENTIAL

25X1

25X1  
25X1

CONFIDENTIAL

- 5 -

19. The water level within a canal may vary up to one meter depending on the canal's function at various times. Generally the water will be at least two meters below the surface of the ground in order to avoid salinity development and the level will usually be below the ground water table in order to avoid seepage losses. As the difference in levels will exceed one or two meters only rarely, no danger to the stability of the canal slopes is anticipated.
20. The underlying layers of earth consist of very loose sandy materials in some locations which limit the depth of a canal. The average soil profile is:

Rumus - 1 meter  
Loess - 3 to 9 meters  
Fine sand - 10 meters  
Fine sand and gravel alternating with layers  
of loam - below 10 meters

21. Water for various individual irrigation systems will be pumped out of the main canals. The water from different drainage systems will flow into the canals by gravity.

#### Water Sources

22. Danube River. The maximum flow of the Danube River at its highest elevation in Yugoslavia, which is at the beginning of the main canal, is 6,500 cubic meters per second. Minimum flow is 10% of maximum flow or 650 cubic meters per second. Minimum flow during the growing season from May to August is 18% of the maximum flow or approximately 1,100 cubic meters per second. Diversion of water from the Danube during periods of low water is limited by navigational considerations as the Danube is an international river with an average yearly transport of four million tons per kilometer.
23. Tisa River. The maximum flow of the Tisa at Senta is four thousand cubic meters per second. Minimum flow is two percent of the maximum flow or 80 cubic meters per second. Minimum flow in the growing season is two percent of maximum flow or 80 cubic meters per second.
24. Hungary, which is situated upstream from Yugoslavia on the Danube and Tisa Rivers, plans to divert 100 cubic meters per second from the Danube and practically all available water from the Tisa. These two rivers are the main source of water at present for Yugoslavia, but it must be assumed that in the future only water from the Danube will be available for irrigation purposes in Yugoslavia.
25. Navigational considerations on the Danube further influence the amount of water available from that source. However, as navigation is still considered possible at a minimum flow of 650 cubic meters per second, there would still be available 450 cubic meters per second for irrigation purposes from the minimum flow of 1,100 cubic meters per second during the growing season.
26. Other rivers in the Vojvodina partly or completely dry up during summer.

#### Responsibility for Development of Irrigation

27. Since the end of World War II, responsibility for the initiation of construction of large irrigation projects has rested with the government. Implementation of projects has been postponed, however, because all available investment capital has been needed for national defense and development of the industrial potential of the nation.

CONFIDENTIAL

25X1

CONFIDENTIAL

- 6 -

28. At present the initiative for development of irrigation projects rests with the cooperative farms, government-owned agricultural units, and individual farmers. This change came about as the result of the complete decentralization of government administration and introduction of "workers' self-management" in nationalized and cooperative enterprises.
29. Financing of large important irrigation projects will be done by long-term government bonds.

Drainage

30. In Vojvodina there are some saline and alkaline soils (sodium chlorides and sulfates) which are not cultivated. This land could be reclaimed with proper drainage. Where the ground water table is very high, cernosem and livacka crnica soils show some alkaline and saline indications. Stronger alkaline reactions are found more frequently at a depth of 50 centimeters (p.H equals 9.5).
31. Studies show that in the whole Vojvodina region, with the exception of the alluvial terrace, the ground water is saline and therefore not suitable for irrigation. Due to the extreme importance of this region to Yugoslavia, the necessity of a good drainage system is obvious.
32. The existing drainage system in Vojvodina consists of 12 thousand km of canals which were built before World War I. Drainage facilities in the Pancevo marshes and in a part of Srem were built in the interval between World War I and II. These drains are open ditches which were constructed by hand. The construction of this drainage system was simple and comparatively cheap because the soils were light and labor costs were low. The system was financed with long-term loans and repayment was made through collection of dues from the beneficiaries. This system solved the drainage problems on 700 thousand hectares to 60 or 70%.
33. In Dalmatia there are only a few drainage systems of which the one near Vrgorsko Lake is important. It has a tunnel of 2,100 meters length.
34. Existing flood control dams in the Vojvodina protect an area of 600 thousand hectares.

Acquisition of Equipment

35. For small irrigation systems sprinkler equipment is imported from Italy, Austria, and West Germany. Imports of such equipment are paid for in foreign exchange. Individual farmers generally cannot afford to buy new equipment. The cooperatives generally make such purchases but at present very little new equipment can be bought.

Land Ownership and Use

36. The land reform act of 1945 liquidated all privately owned large land holdings and individual land ownership is now limited to 20 hectares. Under this system private ownership of land is prevalent. Large government-owned and cooperative units are found mainly in Vojvodina and Slavonia.
37. After World War II efforts to form cooperative farms in order to avoid the disadvantages of operating very small farms were sponsored by the government. Government interference, however, led to a decrease of private initiative on the part of farmers and a corresponding decrease in production. At the beginning of 1953, a reorganization of cooperative farms was introduced. This reorganization gave the farmer a chance to choose the form of cooperative best suited to his individual needs and capabilities. LIBRARY SUBJECT & AREA CODES

25X1

623,893 80M 4/724.14 80M - and - 4/724.17 80M 723.5 80M  
 4/724.11 80M 4/724.11 80M 623,325 80M  
 4/724.16 80M 4/724.11 80M 723.3 80M  
 4/724.16 80M 4/724.543 80M 723.4 80M  
 722.101 80M 722.101 80M 623,323 80M 623,326 80M